

### Effects of Acceleration on the Hostess Twinkie (*Spongius Cremius*)

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The Hostess Twinkie<sup>TM</sup>, a pickle-sized lump of yellow cake containing a few spoonfuls of white "creme filling," has long been a staple of the American diet and is, perhaps, the queen of junk foods. Combining high sugar content, long shelf life, and a generous allotment of fats, the Twinkie is the perfect item for the convenience store and the gas station. It is reasonable to expect that as Americans move outward into the solar system, the Twinkie will go with them.

In a recent discussion of a spacecraft which would ferry crew members to Space Station Freedom, Edmund Hack of Lockheed wrote:

A small cargo area for personal gear is included (you know, CDs, twinkies, videotapes, pictures from home....).<sup>1</sup>

This led to speculation at our laboratory on whether, indeed, Twinkies would survive high-acceleration conditions. If not, space-station astronauts and cosmonauts will have to get along without Twinkies, or manufacture them in orbit. Would the sponge-cake structure collapse? Would the added weight squeeze the lard-and-sugar filling out, smearing it over the family portraits and compact disks?



Mary Janosi and Dave Ifversen perform final payload checkout before launch.

Our group decided to investigate. Fortunately, our crew chief had just returned from the White Hen with a number of standard Twinkies. A typical Twinkie was selected, placed into a plastic bag, and attached to a 2-meter rope. The Twinkie was oriented flat side "down," taking the acceleration the same way it does on the Chicken's shelves. Our centrifuge operator first practiced by whipping an inert object (a roll of masking tape) around his head on a rope. Once he could sustain constant angular acceleration of the desired magnitude, we began the Twinkie run.

Revolution rate was measured by counting 20 revolutions (after allowing for an initial "wind-up" acceleration period) and timing with a digital stopwatch. Elapsed time was 16.9 seconds, giving a rotation rate of 1.18 revolutions/second.

This gave the subject Twinkie an average acceleration of 11.3 gravities... a bit high for a manned launch, but certainly the right order of magnitude.

The Twinkie was removed from its bag and compared to a control Twinkie which was exposed to a 1-gravity field for the duration of the experiment. The accelerated Twinkie had oozed a small amount (perhaps 1 cm<sup>3</sup>) of filling through a small crack in its skin, but appeared otherwise healthy and edible. Its shape and size seemed unchanged.

Our tentative conclusion is that a Twinkie can survive accelerations typical of orbital launches with only minor damage, certainly in edible condition. It seems likely that careful packaging could ameliorate the stresses of space-flight. These results are encouraging, and the Site Op-



The authors confer on the details of the experimental setup.

<sup>1</sup>Internet Space Digest, volume 12, number 59.



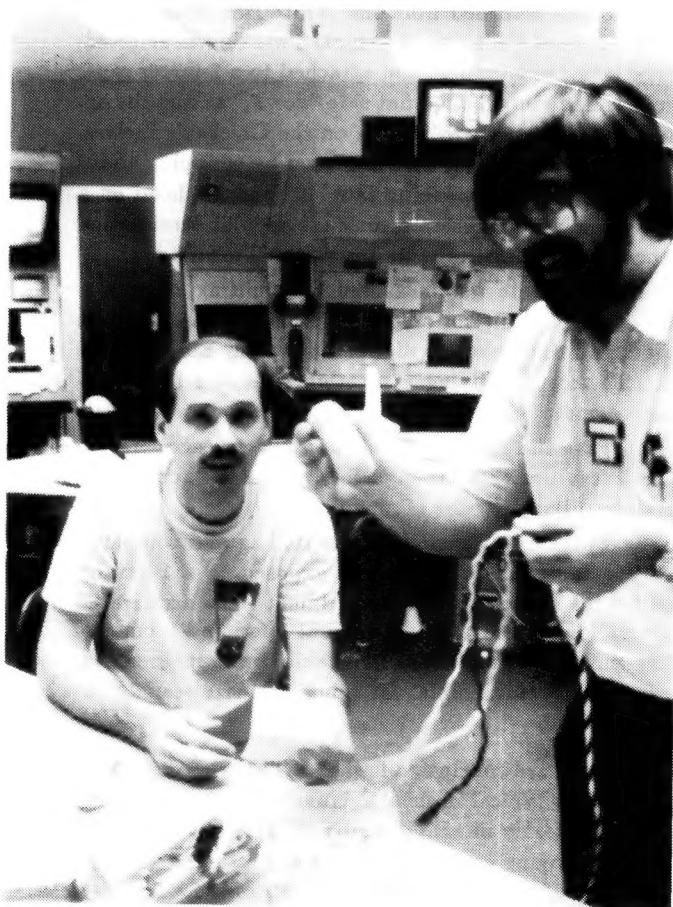
erations Department is now preparing proposals to test potato chips, microwave popcorn, Dove Bars, and other junk foods to determine their suitability for use in orbit. Funding agencies should expect to hear from us shortly.



Centrifuge operator Dave Ifversen subjects the Twinkie payload to carefully measured acceleration.



After flight, the Twinkie which has been exposed to simulated cosmic conditions is compared to the control Twinkie. Slight damage and leakage of the Tasty Creme Filling is apparent.



Despite its harrowing ordeal, the cosmic Twinkie still appears safe for consumption by hungry astronauts.

## Quarks

- We finally have proof that we're living in The Future. We heard about it from Dave Caswell, who got it from Ephraim, who got it from David Gingold, who got it from Gary Sabot, who actually attended the seminar at Thinking Machines given by Eric Begleiter. At Dimensional Foods Corporation in Boston, where Mr. Begleiter is president, they've developed a method for *applying holograms to food*. They can put holographic images into chocolates, lollipops, and medicine tablets. They use photolithography to make molds which have enough resolution to press the diffraction pattern into candy and other foods. DFC is marketing their process to major food producers; if they succeed, we may see images with depth, color, and/or motion in all kinds of snack foods in a couple of years. Of the samples Mr. Begleiter displayed, the most awesome was the chocolate-covered graham cracker with a three-dimensional image embossed in it. That's right, it's called a "Holo-Graham."

- Some of E. Michael Blake's friends get together to play poker once in a while. Lots of people do that. While they're playing, they also discuss the State Of The World, the arts, politics, and so forth. Lots of people do *that*. Not so many people would have decided that the poker table would be the perfect setting for a TV talk show. But Mike did. Why should your guests be confined to swivel chairs or couches when they could be chomping pretzel rods and calling bluffs? So, with Derrick White as director, he rounded up some of the Moebius Theatre gang and herded them into the Chicago Access Corporation studio. The pilot tape featured John Buckley, Mary Susan Bein, Lisa Golladay, Kurt Sakaeda, and Bill Higgins. E. Mike played MC, and failed to win a single hand. The cable

people liked it, so *Who Dealt This Mess?* will be a series airing once every few of weeks on public-access channel in the city of Chicago. Ante up.

• There's a new magazine called *Midnight Engineering* devoted to the techie entrepreneur. If you've started a little software company, or you're peddling your own boards—perhaps without quitting your day job—this could be the publication for you. In between articles on electronics and computers are sandwiched pieces on marketing strategy, business plans, other small-business issues. And it's the first magazine we've seen with a "vaporware" department. It's published by William E. Gates (not the guy who started Microsoft, but he says his phone calls always get returned promptly...). \$24 for 6 issues in the USA, \$32 Canada or Mexico, \$50 other foreign countries.

*Midnight Engineering*

111 E. Drake Rd.

Suite 7041

Fort Collins, Colorado 80525

(303)225-1410

• Speaking of magazines: Gernsback Publications (publisher of *Radio Electronics* and *Popular Electronics*) have started a new magazine called *Science PROBE! The Amateur Scientist's Journal*. Yeah, the capital letters and exclamation point are part of the title. Looks interesting: the first issue covers observing weather, measuring bioelectricity, photographing lightning, and taking aerial photographs from model rockets. Somewhere, that crazy old techie Hugo Gernsback must be smiling. This is just the kind of stuff he would have published in the old days. And it could be a market, if you're inclined to write up one of your projects and make a few bucks. Forrest Mims is heavily involved in producing the new magazine. It's quarterly, \$9.95/year (US\$14.95 in Canada) from:

*Science PROBE!*

500-B Bi-County Blvd.

Farmingdale, NY 11735

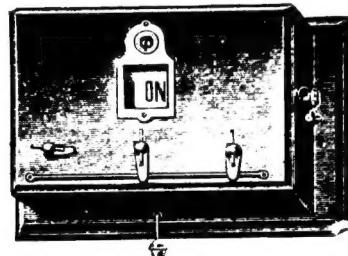
• Out in Hollywood or thereabouts, Mike Jittlov recently appeared on the Big Screen. Mike has an unparalleled ability to pixilate himself—to use his body in animated movies as if it were a stop-motion puppet. Snap a frame, make a tiny move, *snap*, tiny move, *snap*, tiny move, *snap*. Do this all day and you get a few seconds of film. Look for Mike as a pixilated dark angel in the recent movie *Ghost*.

• On the Scitech front, the museum wanted to translate into Spanish the soundtrack to the big "Molecules and Society" multimedia exhibition. The traveling show, which stars a dummy of 18th-century chemist Antoine Lavoisier, is already available in English and French. One obstacle: how to get the exact timings when slides change, robots move, *et cetera*? Todd and Mary Lynn Johnson realized that their video camcorder has an on-screen clock display. So they simply videotaped the whole show, and the problem was solved... The entire *Pyro Technics* staff attended a gala (co-ed) bachelor party this summer. Bill Higgins, best man at the wedding of Jo and Barry Gehm, wanted



"Doc" Gehm loses an argument with a giant gyroscope at the Scitech museum.

to throw a really memorable bash. What's more fun for a bunch of techies than doing scientific experiments? So he conspired with Bonnie Jones and Sam Paris to rent out Scitech for the evening. Everybody played with the giant bubbles, the fiber optics, and the famous Johnson pocket tornado. Wind-physics exhibits were particularly popular, as it was the hottest night of the year. Jo and Barry were married the following weekend, in a ceremony devoid of any Weird Science.



# Book Review

## Haunted by Cybernetic Ghosts

Dale Skran

*Mind Children: The Future of Robot and Human Intelligence*

by Hans Moravec

Harvard University Press, 1988

Hans Moravec is a well-known robot researcher at Carnegie-Mellon University. In *Mind Children* he has produced his first work of speculative science. Although interesting, it is unlikely to win the Pulitzer a la Hofstadter's *Godel, Escher, Bach* or Sagan's *Broca's Brain*.

Initially, Moravec describes some of the history of robotics and his personal part of it. He then works through a calculation of the computing power of the human brain, develops a metric for the comparison of computer hardware with organic brains, and extrapolates computer evolution forward to the point at which first a so-called "supercomputer" and second a personal computer will have human equivalence in raw power (about 2010 and 2030, more or less). Although moderately convincing, this analysis is not complete, and could easily be off by an order of magnitude. However, due to the rapid growth of computing power, this would not delay human equivalence in computers very much.

Moravec then explores the history of artificial intelligence (AI) briefly, and lays out his support for "bottom-up" or robot-based AI as opposed to "top-down" mainframe AI. Moravec splits the difference, and predicts that the two will meet halfway in the fairly near future, resulting in a robot cottage industry as thousands of entrepreneurs strive to produce specialized robots, much as thousands of programmers today labor to produce software tools and games. Moravec envisions, for example, a plumbing robot, a stair-building robot, a window-washing robot, etc.

Moving beyond the immediate future, Moravec makes an argument for personality downloading and "pattern-identity" as opposed to "body-identity." The downloading argument is fairly plausible, especially in its weaker form, which allows for the gradual enhancement of human capacity via bio-cybernetic add-ons. Eventually, the organic part of our brains might be such a small part of the whole as to make downloading straightforward. Moravec dismisses genetic engineering as merely the production of robots using inferior materials.

This opinion neatly sums up one side of Bruce Sterling's fictional (*Schismatrix*, *Crystal Express*) Shaper/Mech stories. In Sterling's fictional future, humanity is divided into two camps: the Shapers, who use genetic technology to improve themselves, and the Mecs, who abhor genetic engineering and rely instead on mechanical and electronic enhancements to the human body. Although I enjoyed Sterling's stories greatly, I always found this dichotomy a bit silly, and was surprised to find Moravec arguing so ardently for the Mech position. One hopes that the conflict

between these two views will not result in the centuries-long war envisioned by Sterling, since both approaches can be used at the same time. Given our history of past conflicts over relatively abstract issues (Protestantism vs Catholicism, Capitalism vs Communism) this may be too optimistic.

To carry the speculation further, even intelligent robots may be body-identified. The real long-term conflict may be between those who prefer bodies (organic and inorganic), and "cybernetic ghosts" who find them inconvenient.

Moravec also mentions a side effect of downloading—backup copies, and considers a few of the implications. This theme is explored in much greater depth by the SF writer John Varley in many books and stories, but notably "Overdrawn at the Memory Bank."

Moravec also discusses the re-creation of the dead via simulation, but unconvincingly. First, except for a very few famous people, we just don't have enough information to create a good-quality simulation of, say, my great-grandfather. A few pictures and a box of letters won't do it. Second, although a person much like the original might result, unless they were directly downloaded, there would be significant gaps between simulation and the original. Note that I am not contending that the simulation would not be human, just that it would not be the original person. Although this might be an interesting experiment, a la Robert Silverberg's "Enter A Soldier, Later, Enter Another," it is not an immortality that would appeal to most.

In one of the more imaginative and original sections, Moravec discusses that possible creation of self-perpetuating information "wildlife" on every level of abstraction (from machine code to high-level software structures), and buttresses his case with some hair-raising ARPAnet stories. He details a cybernetic existence analogous to our biological existence, in which we are surrounded by a sea of parasites and dormant viruses that occasionally give us serious trouble. The recent Signaling System 7 crash that affected long-distance phone service nationwide suggests that Moravec's vision is not far-fetched.

Finally, Moravec considers the possible infinite extension of consciousness either by altering time or by moving beyond our universe. Here he is clearly out of his depth, and is borrowing from better minds than his.

All in all, *Mind Children* is a worthwhile book for those interested in the romance of technology as well as the forward-looking technical professional. Moravec's robot cottage industry may be the basis for the latter half of many of our careers.

## The Natural Wall -- Found!

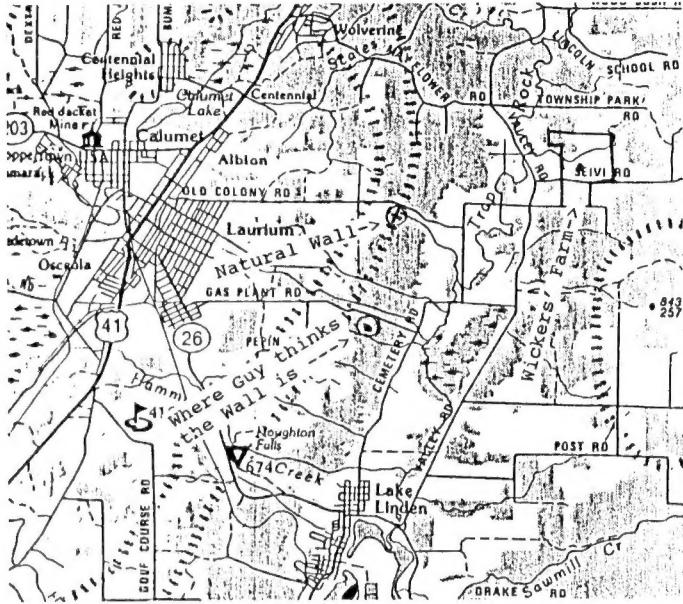
by Fred Robinson

TRAP ROCK VALLEY, Mi. -- I wasn't at Guy Wicker's first Hoton Berserker, in 1987. But I heard most of the stories: Guy's first unsuccessful hydrogen balloon flights, the dynamite demo, etc. Perhaps the most amusing was the search for the Natural Wall.

Apparently, Guy said, "Hey, there's a really neat natural formation nearby. It looks like a huge man-made stone wall, but it's natural. It's



the Natural Wall!" or some such. And so most if not everybody went haring off with Guy in search of this phenomenon. Unfortunately, they started out late in the day, and soon dusk descended on the searchers. After mucking about in the semi-darkness for an untold time, following Guy who was no longer sure of his bearings or even his location, they gave up. In the ensuing years, many people (even me) have ribbed Guy about how the Wall probably doesn't exist at all, and is a figment of his imagination. Guy has insisted that the Natural Wall is a legitimate "natural wonder of the world," and has unsuccessfully tried to find references to it in his somewhat idiosyncratic library.



Over the next few years, at the Berserkers I have attended, we have thought of looking for it when we had enough daylight. Never got around to it, though.

This year, the Berserker was smaller than usual. Guy had no big plans for blimps or like that. Just camping, copper picking, and on Saturday some model rocketry at the farm, followed by a bonfire with flash powder candles and leftover boom-booms on DeBeaubien's beach. During the rocketry, we (John Lussmyer & myself) asked Chuck Wicker (Guy's dad), "Does the Natural Wall actually exist?"

"Oh, yeah," he said, "it's real close by." We agreed to rendezvous at the farm the next day and go out to see it. So, on Sunday (we were going back home Monday) we met at the farm and followed Chuck's minivan around a couple of turns and up Old Colony road. Near the crest of the hill we (John, myself, Chris Oesterling, Tom Snoblen, Tom's co-worker Chemin Kahn, Lee Hart, and Lee's nephew, along with Chuck & Kathy (Guy's "evil" stepmom)) parked near a signpost without a sign, which marked the beginning of a path. Chuck explained that it was just a few hundred yards down the path, and we charged in. Chuck described, as we went, how the people who owned the land on which the Wall stands had blasted part of it away, back in the fifties or so.

A short hike brought us to an extremely steep-sided gully. Sure enough, going about halfway across, was a Natural Wall! It looked as Guy had described it, as if it had been made out of hewn blocks of stone, but completely natural. It is a layer of hard sandstone which has been tilted ninety degrees upward by the geologic forces which shaped the Keweenaw Peninsula. Chuck said that it's part of the same formation that Douglass Houghton Falls is in. I checked later on the map, and sure enough, it's on the same rise as the Falls, being somewhat north of them.

The gully walls are about sixty degrees from horizontal, and are studded with trees and parts of the sandstone layer to which the Wall belongs. We took varying routes down. John and I slid down on our asses from tree to tree; Lee went downstream and found an easier way; I wasn't watching the others. Once down, Chemin and Lee's nephew promptly climbed the other side, from which the Wall projects. Us older people stayed at the bottom, and begged them to, if they fell, not land on us.



The Wall is about three or four feet thick, and maybe twenty-five to thirty feet high. It comes halfway across the gully, which in Spring is one of the meltwater runoff routes. It is made of the reddish sandstone found in the area. Several people have carved graffiti in it. The natural faults in it give it the appearance of a man-made wall, laid without mortar. It sticks out of the south side of the gully (our approach was from the north).

We hacked around down there for twenty minutes or so, taking pictures and whatnot. The climb up was amusing. I found it to be about as close to free climbing as I want to get, especially without ropes and other proper safety equipment. The loose gravel and dirt on the climbing surfaces I chose didn't help either. However, by maintaining three points of contact at all times and using (and breaking) fortuitously-placed roots, I made it up, sweaty and dusty but none the worse for wear. Kathy and Chris chose to walk down the gully to the road, where Chuck picked them up. Chris, city boy that he is, found firsthand evidence that yes, a bear really does shit in the woods.

Perhaps it is a Good Thing that Guy was unable to locate the wall that first year. Given the steepness of the gully, at least one person would have taken the quick way down, especially in the twilight. If, at the next Hoton Berserker, we decide to visit the wall again, I would strongly suggest a daytime visit and the use of good ropes to aid the descent and ascent!

So, Guy, we finally admit that you were right. The Natural Wall does exist. You just have a lousy sense of direction.

## DUELING ROBOTS

### Mike Bakula

MileHiCon 22 (Oct. 26-28 1990, at the Sheraton Lakewood, Denver CO. GoH's: George R. R. Martin and Dan Simmons) will be holding its 2nd annual Critter Crunch this year. Everyone is invited (Hey, FedEx your critter if you absolutely can't make it), we need more targ-- contestants. Here's a copy of the rules.



These rules are a joint production of members in good standing (well most of us were standing at the time) of the Colorado Mad Scientists Club. Bill Llewellyn is in charge of this event, so if you wish clarification of the rules, or if you just want to quibble about how many kilotons constitutes socially unacceptable, call him at (303) 795-9677 evenings before 10pm Mountain time. Critters may be built or bought, but, a word of warning: some of the potential entrants are discussing vehicles capable of significant mayhem, so do not become too attached to your entry.

#### Critter Crunch Rules

0.) No Cheating! This covers spirit-of-the-competition type violations.

1.) Vehicle size will be limited to 12 x 12 x 12". A vehicle may deploy appendages beyond these dimensions. The 12" cube rule applies only at the beginning of each combat and does not include control devices. See rule 4.

2.) Vehicle weight limit is 20 lbs. This includes everything, including control pendant, r/c transmitter, and all batteries. See rule 4.

3.) Vehicles may be powered by any source socially acceptable for indoor use. Vehicle power sources must be 100% contained within the vehicle. Package your source appropriately for the expected abuse.

4.) Vehicle control may be by any method not involving direct contact by the operator. This includes connected pendants and radio control. Pendants may not supply any power to the vehicle. Pendants or control boxes held by the operator do not count against the volume limit of rule #1.

5.) Projectiles, if employed, must be tethered and conform to rule 9. Untethered items may be dropped (not thrown) from your vehicle but must conform to rule 9 and be picked or cleaned up after your combat.

6.) All vehicles must, at the beginning of each combat, be capable of movement at a rate of at least two inches per minute.

7.) The combat zone will be the surface of a table approximately 30" wide by 96" long and will include the airspace above the table to the height of whatever ceiling we have. Leaving the surface of the table or the airspace is permitted as long as some part of the critter is in contact with the surface of the table. No contact with the ceiling is permitted. See also rule 11.

8.) All entries must conform to the general rules of the hotel and the convention.

9.) No vehicle may, under any circumstances, present a hazard to the judge(s) or the spectators, nor a serious hazard to the opposing operator. No vehicle may, in its operation (see rule 11) cause damage to the playing site; table, floor, carpet, ceiling, etc.

10.) The competition will be one-on-one trials or eliminations depending on the number of entries. Vehicles will start from behind a line 12" from opposite ends of the table. Combat will proceed for two to three minutes, at the end of which the judge will declare a winner or draw. Judges' decisions will be final.

11.) To claim a victory, your vehicle must; (a) show mobility, and (b) be on the table. You will be declared defeated if; (a) your vehicle has been rendered immobile, or (b) your vehicle has been knocked off the table. A draw will be declared if both vehicles have the same status at the end of the time limit.

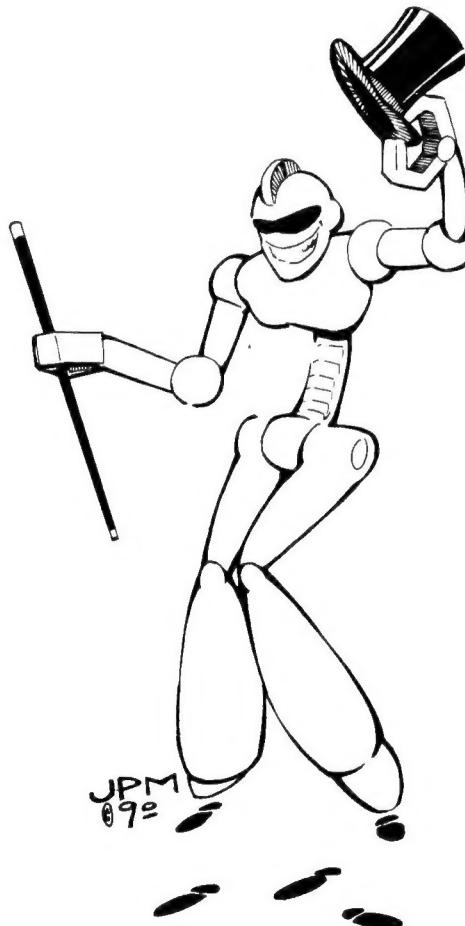
Anyone may enter, however, since the event is part of MileHiCon, all participants must hold a membership good for at least the day of the event.

#### Critter Crunch Rules Clarifications

Following are some clarifications and examples to aid builders in this years critter crunch. These are based on questions I get asked most often.

**Power Sources:** The most obvious is batteries, but don't let that limit you. Any source designated by OSHA as suitable for indoor use is OK. This includes, for example, a 4-stroke internal combustion engine powered by propane. Please include a tilt-switch to shut it off if it is turned over.

**Table Size:** Since I have no idea exactly what will be available, I cannot promise anything specific. Width may be anything from 24 to 36 inches, and length from 72 to 96 inches. The most likely surface is either Formica or smooth Masonite. If your vehicle leaves anything on the table, intentionally or not, please see to it that it is water-based and readily cleaned up. The use of petrochemicals or adhesives that will leave a residue on the table is forbidden. Clean up will be accomplished by the participants.



Deployables: You may hand prep your vehicle for the 12-inch cube, although it must fit the cube unassisted, and deployments must be an automatic or remotely controlled function.

Spirit of the Rules: It is not the wish of the organizers to use the rules to disqualify people on niggling technicalities. Rather the rules should be interpreted as broadly as possible to permit the widest variety of endeavor. The scale nudging the high side of the 20 pound mark will not disqualify you. 21 pounds will.

Projectiles: An object, thrown with the expectation that its kinetic energy will affect its target, is a projectile and requires tethering to prevent it flying into the audience. A stream of water is not. Something that is tossed, so as to disperse it or place it across the table, is not a projectile. Use common sense and don't quibble.

## Interior Ballistics, International Incidents, Career's End

Frank Bynum

### Part II

*In Part I [see Pyro 46] Frank Bynum reviewed recent Iraqi attempts to acquire advanced military technology. He traced the career of the Canadian artillery designer Dr. Gerald Bull. In the 1960's, Bull led the High Altitude Research Project (HARP), culminating in huge guns which fired rocket-assisted projectiles into space. Developed versions could have been capable of launch into orbit, but HARP was canceled and Bull became an arms dealer and consultant. Recent evidence that Iraq had purchased components of an even bigger gun turned up shortly after Bull was murdered in Brussels this past April. In Part II, Frank reviews what is known about the Iraqi gun, and considers some of its strategic implications.*

#### Iraq's Big Gun

The Iraq story unfolded further as spring of 1990 wore on. On 5 May, ATC cited further interceptions of Iraq-bound shipments. [15] The interception occurred in Italy, preventing the export of "about 70 to 90 tons of metal parts." US and Western European customs officials said their actions hindered another attempt to circumvent the current embargo against the Persian Gulf countries' arms imports. Similar orders were found to have apparently been placed with companies providing industrial equipment and supplies in a number of separate Western countries. The purchase agreements gave petroleum industry use as the purpose.

Interviews again suggested a "big gun" project by the Iraqis, able to bomb Israel or Iran with nuclear explosive, or toxic chemical artillery shells. Under this thesis, some of the parts (including hydraulic components) stopped in Italy could relate to making the rear part of the cannon.

As had earlier news stories, this one identified Dr. Gerald Bull as having become the chief architect of the design, called "Babylon." [15] A few numbers were given: tube length of 40 to 45 meters, range of "200 or more kilometers." The 200 km range seems to be about a tenth the potential of the artillery-dart/upper atmospheric research

probe behind the *60 Minutes* story at the end of the '70's. If used for horizontal range rather than its normal vertical probe flights, supposedly one of the HARP projectiles could potentially reach Mexico City, from McGill University, where the project was managed, in Montreal a bit north of the US /Canada border—a distance of 3790 km. It is about 405 km. from inside the south western Iraq border to the main part of Israel.

A British customs official told *US News* the Iraqis ordered parts for making two big guns. [17] They code named them "Baby Babylon" and "Big Babylon." The first was 120 feet long with a 16-inch bore, the same size as its predecessor in HARP. During tests in Iraq it failed. Its replacement parts were intercepted by British Customs. Big Babylon, 512 feet long with 39-inch bore diameter, would be built in 52 pieces. Already 44 had been shipped. The remainder, 298 tons of polished tubing, were seized by Customs.

The second cannon design could shoot rocket-boosted projectiles unprecedented horizontal distances when tilted near 45 degrees. In his book, published in 1988, Dr. Bull wrote about how satellites could be launched by the technique. Approximately 5000 miles horizontal range could be achieved by his 1960's version, using a 16-inch bore and 3-inch projectile using three rocket stages. The customs officials "guess it certainly was intended as a launcher for satellites, but there's no reason to preclude launching anything else."

#### Countering "Mass Destruction" Weapons

It should be remembered that each of the following countries have been among the third generation to demonstrate rockets able to launch satellites, and at other times be intermediate or long range missiles: Israel, Iraq, India. (The first generation was USSR and USA. The second generation was Western Europe, China, Japan. Only Japan, and purely private space launch services companies, seem likely to keep the capability truly confined to purely civilian applications, at least for the immediately foreseeable future.)

Recently Dr. Bill Campbell reviewed Third World military technology. [18] The good news was that now Brazil joins the 3rd generation of those nations having space rockets or long-range missiles. The bad news is that he sees indications Iraq may now have about 25 pounds of plutonium—enough for 3 to 5 fission bombs, depending on efficiency of the selected design. Israel's 1981 bombing of an Iraqi reactor site (which was optimized for plutonium generation) only put the plant off-line until this year.

Campbell's response to questions about any association of Iraqis, or allied individuals abroad, with biological warfare was slightly less bad. So far, it merely remains obviously easy in theory. Recognised incidents comparable to Iraq's demonstrated past use of war gases aren't yet apparent.

In potential arms races between technologically modern countries—all undesirable—certain directions are less undesirable than others, as I have written on previous occasions. My vote goes against reliance on "mass destruction" weapons, in any of the NBCR (nuclear, biological, chemical, radiological) categories. Instead, I favor mea-



sures designed to defeat systems used to deliver NBCR weapons swiftly over sizable ranges.

What relation is there between the Iraqi "Big Gun" project and "mass destruction" capabilities? "Mass destruction" weapons usually operate by one of the NBCR effects, impacting an area of many tens to thousands of square kilometers for each device used. If built, the cannon could accelerate pieces of stuff, each a few hundred to few tens of thousands of kilograms in mass, in particular directions. Bombers, rocket missiles, and war gas already are on hand, and have been previously employed. Nuclear explosives are inaccessible to Iraq until a future date. Nor is completion of the Big Gun project yet assured.

The reader may ask what is meant by countermeasures to NBCR armaments. On one hand, there are the weapon devices themselves. On the other hand are the means to deliver said devices from the arsenal into territory where their owners might choose to stage an attack.

The delivery means of most concern are aircraft, missiles (using aerodynamic lift and air-breathing propulsion), or projectiles sent on a ballistic path (by use of rocketry or artillery). One reason for concern is that these delivery systems have been important in the past, or may be newly available to a given nation. Another reason is that all these methods share a few traits: sizable ranges, short delivery times, and availability in significant numbers. (Aircraft, missiles, and ballistic projectiles require, at most, minutes to hours in order to advance over typical strategic distances. In contrast, if these means are mutually unavailable to militarily similar antagonists, ground forces would take at least days to weeks.)

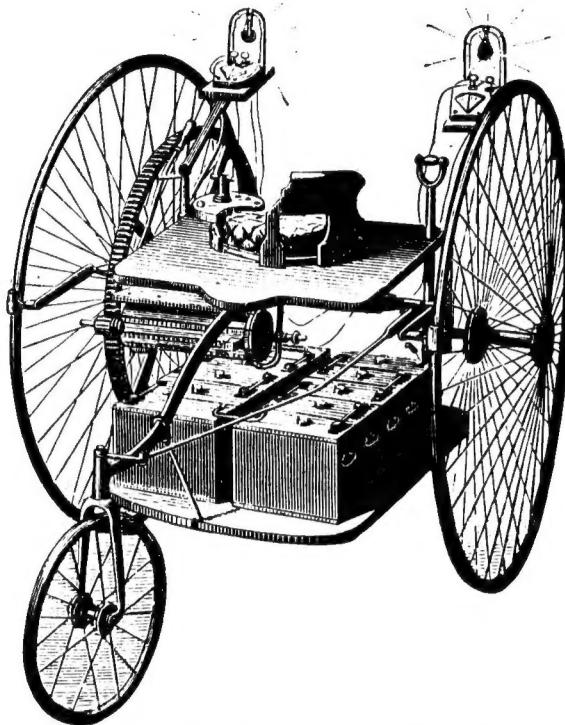
Passive countermeasures are steps able to reduce casualties, damage to essential equipment, and loss of stockpiled supplies which would be suffered if one or many area attack weapons arrived on targets in one's own territory. Among the applicable elements are: contingency plans for population relocation (which must count on advanced warning of days); shelters (different types are required against different effects); protective equipment, clothing, and breathing gear; well-distributed, sizable, protected, caches of emergency food and water supplies; and public warning systems. Public exercises to practice such plans would also be essential. This is usually called civil defense (CD). Against the risk of general nuclear war, some Scandinavian countries were able to sustain meaningful implementations of this type, while the USA and UK were not.

Active countermeasures are directed at preventing the arrival of the delivery systems. For these, useful items are radar and other sensors, air-defense (aircraft and missiles able to destroy incoming enemy aircraft), and ballistic missile defense (BMD). Another item may be a pre-emptive attack against an antagonist country which was uncomfortably "well prepared." To be effective, it is necessary but not sufficient that the attack must be able to, and directed to, eliminate those specifically military implements and facilities which provided the capability to carry out the feared attack, before they might be called into use.

#### SDI and the Big Gun

Are there active countermeasures one could use against a Big Gun?

Often, in the present debate about the Strategic Defense Initiative, a particular objection is raised against boost-phase interception ideas. One of the participants will state blithely that the whole thing gets rendered worthless by changing ICBM's to use boosters which burn for a much shorter time, for the same change in velocity. The



guessed change might be from about six minutes burn time now (for a three-stage rocket) to perhaps three minutes on an upcoming generation of missiles. [19]

Implied by the "Iraqi Big Gun Flap" is what amounts to the ultimate in the notion of "short burn-time booster," which SDI detractors warn would keep ICBM's unstoppable. The weapon goes from rest to maximum speed in a small fraction of a second. Would the gun, or its projectiles, be vulnerable to countermeasures? Certain promising approaches may exist which aid in making even these bombardment systems not at all unstoppable.

There are two main approaches to ballistic missile defense (BMD). One is directed energy weapons (DEW), such as lasers or particle beams. The other is material projectiles (kinetic-energy weapons), either rocket-propelled or gun-fired.

The question may be asked, how "hard" may a given sophisticated weapon system be, if it were to be attacked? It is expected that ground-based (on this planet that equals 'endo-atmospheric') cannon-type system would inherently be hardened, on average, and amenable to measures for increased hardness.

The combination of average power and permissible run time, for weapon lasers, is currently quite limited. A "blow torch" equivalent effect may well do in a normal rocket carrier vehicle. But drilling into inches-thick armor would require more potency than is available soon.

Beam attenuation while propagating through the atmosphere is a manageable design detail. Either DF or

chemical oxygen-iodine lasers offer acceptable propagation through air. The amount of energy per unit area needed to produce structural failure is likewise modest for the very light weight structures of aircraft or normal missiles. But it is very high for inches-thick steel plating or earthen structures. (We need not assume space-to-ground DEW here. Rather, airborne beam generation, or airborne relay optics with ground-based beam sources, are possible. Implementation of 200-kb platforms in orbit, for any purpose, is not a likely near-term option for Mid-East countries.)

If you give up the nicety of "speed-of-light action," then hypersonic BMD projectiles against the gun's projectiles, or against the guns themselves, will probably have plausible efficacy.

#### If Iraq Rattles a Cannon for The Bomb, Might Israel Like ABM?

One Mideastern nation is already working on such weapons. Press reports mention involvement of Israeli researchers in studies of anti-tactical-ballistic-missile defense. On 9 August 1990, they conducted the first flight test of the Arrow antiballistic missile. [20] The Arrow may be an active countermeasure to threats such as Iraq's Scud-8 missiles, which can threaten Israel. It is conceivable that a similar system might defend against Big Gun attacks.

A bit later in August, transfer to Israel of Patriot missiles from the U.S. was in the news. Over the years, various sources mention that this ground-to-air missile has a "residual potential" to act in an ABM role. To do so, the software is modified.

During its earlier, brighter days, while less subject to substantial cuts of its budget, the US Strategic Defense Initiative Organization had encouraged such programs, complementary to its own, on the part of other allied nations. It might be in their interest for the Israelis to continue pursuit of such developments.

SDI research is now in decline as budgets get tighter in Washington. Even if the US might not, at least some nation, with whom we are on good terms, should take the lead in providing demonstrations of ABM technology credibility.

The imminence of possible major combat in the region leaves the relevance of science and technology R&D elements an open question, however. Perhaps events might outpace technical developments. Or, in the context of "the wizard war," developments of impressive, new, real capabilities—not mere vaporware—may occur. Red tape tends to vanish in a visible emergency. In wizard war, scientists use their special talents to seek important military advantage in the day to day shifting situation. Radar, Ultra, and the Manhattan Project were 1940's examples. Anti-tactical-ballistic-missiles, electronic warfare, hypersonics, and other strange gizmos may now fit the idea. (Vaporware is the computer industry's term for advertising a desired feature, without having provided it yet.)

#### Conclusion

The recent legacy of HARP, this time making it into the daily news, has been discussed here. Yes, "someone else" decided it was worth trying. It indeed is one of the means available for "pipelining" civilian cargo inexpensively into

space. The Proper Sponsors, must still be found to obtain that end which we space development proponents desire. Gleaning funds, even from military sources, isn't necessarily incorrect. But risks of getting hooked in with certain regimes—those particularly prone to leap boldly into major armed conflicts—should give one pause.

Dr Bull, the cannon's leading designer, had in the past expressed interests in civil space satellite launch capabilities. They may have been among the things to be flown in this instance, though that's not certain. Politics never is. If nothing else, at least the design experience itself could have contributed to a step in that direction—if it wasn't lost by his murder. (Somewhere there must be vaults of design documents!) In any case, sympathies are expressed to his surviving family members and colleagues.

#### References

- [15] *All Things Considered*, on National Public Radio, Monday, 5-14-90.
- [16] Daniel Burke, "An arms expert in exile," *Maclean's*, v98 p9(2), 18 Feb.'85.
- [17] A make-my-day superweapon (Gerald Bull and arms for Iraq), *U.S. News & World Report*, V108 p48(2), 4 June '90.
- [18] Dr. Bill Campbell, Political Science Department, Miami University, lecture delivered Monday, September 17, 1990 in Oxford, Ohio.
- [19] *Report to the American Physical Soc. of the Study group on science and tech. of directed energy weapons*, c.1987. Also Jim Scheftner (text), D.M. Davidson (illus), "Missile Killers," *Popular Science*, V233 N8, p46(7) Sept.'88. (SDI proponents speak about effective space based interceptors. Some opponents feel this element to be overpriced, unworkable. Practicality may be unclear for a decade or more. Entries from Martin Marietta Co. and Rockwell International are shown.)
- [20] "Israel successfully launches first antiballistic missile," *Aviation Week & Space Technology*, 13 Aug. '90, pg 23.

## BEYOND THE "D" CELL

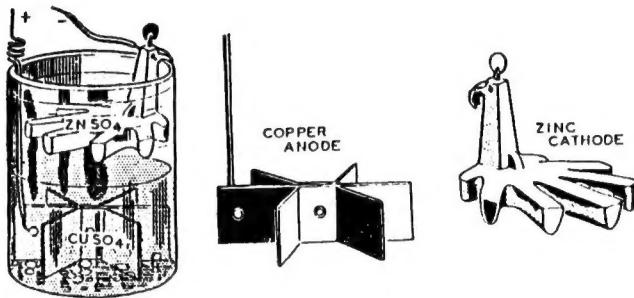
from Robert M. Alway:

I was interested by the query by Franz Zrilich in the last double issue of Pyrotechnics for information regarding the largest "dry" battery available. The way the note was written I assumed what was really being inquired about was the largest available primary or non-rechargeable battery.

The largest primary cell I am aware of ever being built in quantity is the Danielle cell or zinc-copper sulfate gravity cell. I have enclosed a drawing of such a beast as photocopied directly from *Adventures in Electro-*



chemistry © 1959 by Alfred Morgan. (Charles Scribner's Sons, Library of Congress catalogue card number 59-7208.) The Daniell cell was used to power telegraph lines for many years, in fact, I have heard that such batteries may still be in use for telegraphy in South America. You may notice that the cell is contained in a large glass jar. This is literally the origin of the term "Battery Jar" for the large cylindrical flat rimmed glass jars that in recent years have been used for chromatography, fish tanks, and anything except batteries.



The Daniell cell has certain limitations, for example, it is not rechargeable, it works best on a closed circuit (i.e. where there is a constant current drain) and tends to degrade on standing when not in use. Much of the degradation can be stopped by removing the zinc electrode when the battery is not in use. While not rechargeable, the battery may be, and regularly was, refurbished by replacing the zinc electrode and copper sulfate consumed during the operation of the cell.

I am not certain if there was a standard size to these cells but I have heard a report of six-inch-diameter zinc "crowfoot" electrodes. I suspect various sizes of cells were made, some very much larger in size than six inches. I have seen what I presumed to be the remnants of a gravity cell at Edison's Menlo park laboratory at Greenfield Village in Dearborn, MI. All that was left was a battery jar with a few blue copper sulfate crystals lying at the bottom.

Come to think of it, if any of your reader's can tell me where I could get a crowfoot electrode or twelve at a reasonable price, please let me know.

from David W. Peters:

I am responding to your request for info on large dry cells. In researching this subject I enlisted the help of Dr. R. R. Witherspoon of the G. M. Tech. Center, Electrochemical Department. Dr. Witherspoon has several patents in lead-acid batteries and his experience goes back over forty years.

First, a little background on dry cells. As most of you know, a carbon-zinc cell can only generate 1.5 volts. (Lithium batteries will provide 3 volts but so far are only being produced in small button-type batteries.) All your higher voltage batteries are made by connecting several 1.5 volt cells together and then sealing them in a package. If you were to disassemble a 9 V transistor battery, you would find six small cells stacked together.

Understanding this, we will look at two possible "largest" batteries. The first is the largest 1.5 V dry cell ever produced, which to the best of our knowledge was and is the number six dry cell. This is a cylindrical battery approximately 8 inches tall and 2.5 inches in diameter, with two screw-type terminals on the top. You

may remember these from those old movies in 3rd grade science class.

The largest battery in terms of voltage had to have been made by Ma Bell back in the fifties. These were 45 and 90 volt batteries made from 30 or 60 double D cells. A double D was the diameter of a standard D cell but twice as tall. Ma Bell used these for power backup for the telephone system back in the bad old days, and each battery was capable of delivering 45 or 90 volts at five amps!

I hope this helps Franz out. If he wants to create a larger battery for his story, he should look into air cells. These are batteries which actually use air as the cathode. These little gems have an almost infinite shelf life since the cathode is sealed until they are ready for use. Once the seal is broken, they produce electricity for about sixty days. They are light-weight, very efficient, inexpensive, and have a very flat discharge curve. Although they are only being produced in button size for now, I see no reason a large air cell could not be made.

*[Editor's note: the September 1990 issue of Scientific American contains an ad (p. 47) for what appears to be an air cell battery about as big as a filing cabinet, made by a company called Alupower Inc. (150 Mount Bethel Road, Warren, N.J. 07059) --BDG]*

from Franz C. Zrilich:

Re my search for large-size primitive batteries, I've since done a lot of research and have made these discoveries:

The largest dry cell is the #6, a 6-inch tall, 2 $\frac{2}{3}$ -inch diameter monster. The largest batteries that use carbon-zinc dry cells are NEDA/ANSI 935 and 903. The 903 is plastic-cased and measures 8 $\frac{3}{16}$  inches long, 7 inches tall, and 5 $\frac{5}{16}$  inches thick and weighs 12 $\frac{1}{2}$  lb. These are 12-volt affairs that can support a 947 flasher bulb for a month--they are normally used in highway barricade flasher systems.

The 935 provides 7.5 volts on a continuous 1.67 ohm load for up to 5.6 hours with a final voltage of 3 volts. At a rate of 30 minutes per hour for 8 hours per day at a load of 2.7 ohms, we can push out to 13.8 hours before voltage drops to 3 volts. Weight is 7.5 pounds, size 7 $\frac{3}{16}$  x 6 $\frac{5}{16}$  x 4 $\frac{3}{16}$  inches.

Some small manufacturers still make NEDA 904s, which are 9 volt units that measure roughly 8 $\frac{1}{2}$  x 4 x 6 $\frac{3}{8}$  inches. Bright Star is one maker, and they make lanterns that fit over these batteries. They look a lot like small WWII anti-aircraft searchlights mounted on miniature automobile batteries!

SAB Nife of Greenville provides plastic-cased zinc-carbon air batteries that are activated by water. As with zinc-carbon dry cells, they are non-toxic if left in an instrument package in an environmentally sensitive area. Their largest battery weighs 420 lbs, measures over 64 x 17 x 15 inches, and provides 12.5 volts for 3000 ampere-hours. They used to be used in rural telephone systems and railroad telegraph stations. Now they are used in remote instrumentation packages and Coast Guard buoys.



# Book Review Technopranks in Pasadena



## *Legends of Caltech*

by Willard A. Dodge, Jr., Reuben B. Moulton, Harrison W. Sigworth, Adrian C. Smith, Jr.  
California Institute of Technology Alumni Association  
Pasadena, California 1983

## *More Legends of Caltech*

by Willard A. Dodge, Jr., Reuben B. Moulton, Harrison W. Sigworth, Adrian C. Smith, Jr.  
California Institute of Technology Alumni Association  
Pasadena, California 1989  
(sorry, no ISBN numbers)

*The only access to Tournament Park is by way of a traffic signal between Bridge Lab and Sloan. During commute hours the signal is very sympathetic to traffic on California Boulevard. It will stay green for several minutes in that direction, but allow pedestrians to cross California only for about ten seconds.*

*The Caltech minds immediately went to work on the problem, and considered such sophisticated feats as resetting the timers. But elegant solutions to problems are simple solutions...*

*Locks were picked on the Corporation yard and a cherry picker dispatched at 2:00 AM to the site of the signal. There with the use of a Phillips screwdriver the plastic covers on the traffic light were reversed so that the green lens was on top and the red lens on the bottom. The cherry picker was returned to its normal resting place, undetected, and the lady secretary had absolutely no problem crossing California Boulevard the following morning. However, traffic on California Boulevard was backed up for miles in both directions...*

*The best part was brought on by the Pasadena City electricians who were dispatched to fix the problem. All morning and afternoon the maintenance crew disassembled mechanisms, laid them out on the lawn in front of Bridge, scratched their heads and looked again at the complex electronic mechanism before them, seeking a complicated and hence inelegant solution to a very simple and hence elegant problem. They didn't notice until hours later that the green light was on top.*

When techies gather to swap stories of their exploits, many of the best ones revolve around The Stunts We Pulled Back In College. It is a pleasure, then, to note the publication of two collections of technopranks from the California Institute of Technology. This school has long

held a leading position in the hierarchy of American practical jokers. Four alumni of assorted vintages undertook to gather examples of the art from their peers. Some, such as assembling Model T's or cement mixers in the dorm rooms of hapless victims, were typical of any college. Some, such as the Great Rose Bowl Hoax of 1961, have passed into American legend.

Among the important skills students acquire at Caltech, apparently, are lock-picking, rappelling, artillery spotting, and music appreciation (specifically, playing "The Ride of the Valkyries" as loudly as possible). In these pages, offices vanish overnight, motorized blackboards perform dances, particle accelerators suffer mysterious transformations, and professors race to finish their lectures as classroom clocks hum to unnatural frequencies.

*But it takes a great orange cannon to propel an orange from Ricketts Court to Pasadena City College... using properly graded oranges and a long, long piece of down-spout, a nitrogen cylinder carrying 2000-psi nitrogen, a valve, and a bursting disc... Every noon at precisely the stroke of 12 an orange or two would plop out of the clear blue sky onto the campus of PCC.*

The first volume, *Legends of Caltech*, gives us the infamous McDonald's Affair: a 1975 sweepstakes which required participants to print their name and address on a 3" x 5" piece of paper, and deposit the paper under participating Golden Arches. As a wise man once said,

```
DO 200 I=1,N
WRITE(6,2000) NAME,NAME,NAME,NAME,ADDR,ADDR,ADDR,ADDR
200  CONTINUE
```

Twenty-six students were each named in 40,000 entry forms chattering out of the System 370's line printer (they scrupulously paid for the paper and the CPU time). They were deposited in 98 McDonald's across Southern California. Once the story broke, it triggered a PR war between Big Mac and the denizens of Page House, as well as a flood of letters from an indignant public. Eventually, the million entries won students a station wagon (donated to the United Way), \$3000 in cash (donated to Page's dorm fund), and \$1500 in gift certificates (presumably eaten). Then McDonald's held a second drawing for equal prizes, excluding all Caltech entries.

Oh, yes. The Rose Bowl. It's in Pasadena, too, you know. Quite a stadium. But for some reason, Caltech never seems to play in the Rose Bowl Game. In 1961 it was the Washington Huskies *versus* the Minnesota Gophers. Festivities would include Washington's card-stunt section, 2,232 students acting as human pixels. Each would display a colored square of cardboard, according to a preprogrammed plan, to spell out a grand message or drawing and even animate it.

*Unless you know ahead of time, there's no way that you, as an individual member of the card section, can figure out what composite picture or word the entire section is putting together for the outside world. Until the thousands of cards are held up, there's no way the card stunt leader can tell exactly what's going to happen either.*

If you want to know the details, they're in *Legends of Caltech*. Pose as a reporter for a high-school newspaper. Get the proud head cheerleader to explain how it



all works. Borrow the instruction cards from his hotel room. (Lock-picking comes in handy again.) Get duplicate forms printed up. Hack the new patterns. Get help from the guys and gals at your New Year's Eve party at filling out the instruction cards. Leave the first 11 stunts alone, so everything looks normal. Then turn the Husky into CIT's Beaver. Thrill as 2,232 pixels spell out "CALTECH" on national television...

Among the highlights of *More Legends of Caltech*: A hilarious account of an attempt to build a *really* loud amplifier. Distracting the Red Car driver while the streetcar's rear wheels are being welded to the tracks. A nightclub owner's form-letter offer to pick the most beautiful girl on campus, from photographs. (Adroit lighting, a good photographer, and careful coaching on wigs and makeup can make anyone more beautiful. The PR stunt backfired when *Life* revealed what the Hollywood guy should have known, printing the pictures of the Caltech queen and her runners-up. Coeds were still thirty years in the future, on this campus.) Son of the Rose Bowl Hack: A radio-controlled 8086 device intercepted commands between the PDP-8 and the electronic scoreboard.

Caltech 38 MIT 9

*Later, during an interview, a Rose Bowl official said that at the moment the team names were changed, the first reaction of the scoreboard operators was to exclaim, "How did they get lowercase characters?"*

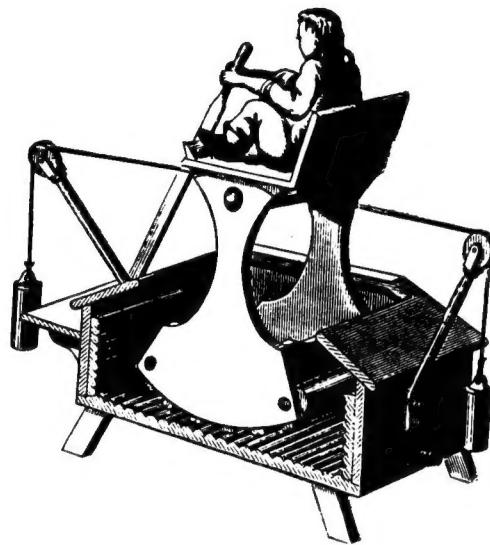
Perhaps the most massive project portrayed in the second volume is the 1987 alteration of the HOLLYWOOD sign. This stunt involved careful measurement of the 33-foot letters in a pre-prank reconnaissance, elaborate preparation of dark and light masks to cover them, and safety training of dozens of Techers in the use of climbing equipment. Not to mention the formation of a Prank Club needed to apply for student-government funds. On May 18, the 100th anniversary of Hollywood, the natives awoke to see... well, by now you can probably guess what the letters spelled.

Bottom line: The books are good. Funny. Very techie-oriented. And the sequel is about as good as the original. They belong in the library of every serious student of the practical joke. (Whatever that means.) To get them, phone Caltech at (818)356-6811 and ask for the bookstore. You won't find them at B. Dalton's, will you?

If you know anybody who's about to start college, I recommend these books as a graduation gift. Start 'em off on the right foot. Beats a thesaurus.

Now, if you went to Caltech, you are yelling at this point, "But he hasn't said a *thing* about Ditch Day! Or the art of Stacking!!" If you didn't, rest assured they are

well covered in both books. But what you should do is this: Find a Caltech graduate. Ask about Ditch Day. (Be sure you have a couple of hours.) You'll enjoy it. Trust me.



#### TALL TALE TELLERS - WE NEED YOU!!!

Mary Lynn S. Johnson

This issue of PYRO contains a review of *THE LEGENDS OF CALTECH*. Having read this review, it got me to thinking that General Technics has plenty of its own stories to tell about exploits, rescues, kluges, dirty tricks, and adventures we've experienced in the world of science and hardware tinkering. These stories have been a staple for years at GT gatherings being told time and again as some of the great legends of fandom. There are tales of Bob Trembley's hypnotism, Cap'n Al's rooftop reflectors, Renee' Sieber talking to suspicious police officers while completely wrapped in Mylar tape, the Portugese Man O' War blimp that was launched from Tom Snoblen's house, the dry ice follies, the high-voltage follies, the house of snakes that Michael Davis lived in, lab near-explosions, big explosions in the meadow, green rivers and waterfalls, laser mishaps and mischief, tanks of hydrogen and helium, and so on and so on and so on. We'd like to fill PYRO's 50th issue with such tales of mayhem, but we'll need to get some help from you folks.

Unlike the Caltech book, the stories don't have to be just about tricks played on other people. Just sit down and write out some of the kind of tales you commonly would tell to some of your techie friends.

They don't have to be funny, or even typed. Just jot 'em down and send 'em in. We'll do the rest. I've already written two and I have a third working. (They might be about you!) Tell your side of the story, set the record straight. This is your chance to regale us with your own legends. We'd like to spend some serious bucks and make the 50th issue a big one, but it won't happen if you don't send something in.

Thank you for observing all safety precautions.



Yes, this really is an ->advertisement<-

### Scale Model Rocketry

Methods and Data for the Historian/Craftsman  
By Peter Alway

This book will tell you everything you need to know to build fine scale models of historical rockets for Scale and Sport Scale contests and for your own satisfaction.

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If you've been meaning to build scale models, Scale Model Rocketry includes simple plans for weekend projects. Or, if you prefer to design your own, this book can get you started turning scale data into plans for your own unique model.

A collection of contest proven hints and tips will help you build quality models without complex and expensive high-tech tools and supplies.

**Rockoon, Nike Deacon, Aerobee Hi, Asp, Nike Cajun**

**Terrapin, Nike-Asp, Aerobee 30, Aerobee-150A, Regas**

**Delta 1, 2, 3, Trailblazer 1, Nike-Pache, Aerobee 500,**

**Ram 1, Nike-Tomahawk, E-2eg, 1in Tomahawk, Aerobee**

**Wang and, June 1, 2, 3, Score, Delta B, Delta E**

**Sco, Titan 1C, Thor-Able 100, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 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